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Efficacy of the Cybersonic in comparison with the Braun 3D Excel and a manual toothbrush

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Abstract

Objectives: To evaluate the efficacy of two power toothbrushes (Cybersonic and Braun 3D Excel) and one manual brush (Elmex super 29).

Material and Methods: After professional toothcleaning 120 subjects were randomly assigned to three groups. Four weeks later, at baseline, the Quigley–Hein plaque index (QHI), the modified approximal plaque index (API), and the papillary bleeding index (PBI) were recorded. Thereafter the subjects used the assigned toothbrushes for 8 weeks. Improvements of the indices after 4 and 8 weeks were calculated as medians. Kruskal–Wallis- and Mann–Whitney *U*-test served for statistical analysis.

Results: All indices showed statistically significant reductions for both power toothbrushes which were superior to the manual brush (4 weeks: Cybersonic: API, 0.21; PBI, 0.25; QHI, 0.23; Braun: API, 0.20; PBI, 0.39; QHI, 0.22; Elmex: API, 0.04; PBI, 0.02; QHI, 0.07; 8 weeks: Cybersonic: API, 0.28; PBI, 0.36; QHI, 0.41; Braun: API, 0.36; PBI, 0.61; QHI, 0.35; Elmex: API, 0.03; PBI, 0.10; QHI, 0.08; $p<0.001$). The Braun was superior to the Cybersonic with respect to API after 8 weeks ($p<0.05$) and PBI after 4 and 8 weeks ($p<0.01$).

Conclusion: Cybersonic and Braun 3D Excel may be more efficacious than a manual toothbrush in removing plaque and reducing gingivitis.

Key words: clinical study; oral hygiene indices; parallel design; power toothbrush

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Since dental plaque is an essential etiological factor of caries and gingivitis (Fehr von der et al. 1970, Löe et al. 1965), efficient plaque removal is an important measure to prevent these diseases. In order to render home-based oral hygiene measures more effective, many types of power toothbrushes have been developed recently. These developments can be divided into two main groups: (1) brushes with a small round head which shows rotation–oscillation action and (2) devices with a so-called sonic action. The main representative of the first mentioned group is the Braun Oral B Plak Control (D 17, Braun, Kronberg, Germany) with various types. Representatives of the second group are the Phillips Sonicare (Snoqualmie, WA, USA) and the WaterPik Sonic Max (FortCollins, CO, USA). In previous studies, sonic toothbrushes showed good results in subjects which had never used a power toothbrush before and had underwent a short instruction only in the use of these devices (Zimmer et al. 2000, 2002). There is evidence, that the efficacy of the sonic brushes arises from microstreaming in the saliva–toothpaste–slurry which is caused by the high-frequency movement of the bristles (Hope et al. 2003, Hope & Wilson 2003).

Recently, a new sonic toothbrush, the Cybersonic (Amden Corporation, Carson, CA, USA), appeared on the market. The purpose of the present clinical study was therefore to evaluate the efficacy of this new device in comparison with the Braun Oral B 3D Excel (D 17) and a conventional manual toothbrush.

Material and Methods

One hundred and twenty healthy volunteers (60 females, 60 males; 18–65 years old) took part in the parallel-design study. Subjects were excluded from the study if they wore fixed orthodontic appliances, had severe periodontal disease, long-term use of drugs with anti-inflammatory effects within 1 month prior and/or during the study, removable dentures, less than 20 natural teeth, or regular use of an electric toothbrush during the past year.

Severe periodontal disease was defined as the presence of one of the following clinical findings: attachment loss of more than 4 mm in a minimum of three teeth, any furcation involvement or pathological tooth mobility. Furthermore, dentists, dental hygienists, dental assistants as well as dental students were excluded from the study.

All participants showed a papillary bleeding index (PBI) (Saxer & Mühlemann 1975) per tooth ≥ 0.5, and a Quigley–Hein plaque index (QHI) (Quigley & Hein 1962) per tooth ≥ 2.0 at a screening examination. By using the stratification by sex and PBI (female: ≥ 1.08, and < 1.08; male: ≥ 0.96, and < 0.96), the 120 participants were randomly assigned to three groups with 40 subjects each. The screening examination was followed by professional toothcleaning to remove plaque and calculus. To achieve standardized conditions, each subject received the same toothpaste (Elmex, GABA, Lörrach, Germany) and a new toothbrush (Elmex super 29, GABA, Lörrach, Germany). The three tested toothbrushes were the Cybersonic (Amden Corporation), the Braun Oral B 3D Excel, and the manual brush Elmex super 29 (Fig. 1). The brushing head of the Braun Oral B 3D Excel combines side-to-side oscillations at a frequency of 73 Hz with in- and outpulsations (333 Hz), resulting in a 3D-movement. The movements of the Cybersonic are generated by an excenter disk in the handle causing vibrations of the whole device including the flexible mounted bristle tufts at a frequency of 342 Hz.

Four weeks after screening, the baseline examination was carried out. The Turesky-modification (Turesky et al. 1970) of the QHI (Quigley & Hein 1962), the approximal plaque index (API) (Lange et al. 1977) in a modification based on the Silness & Löe plaque index (Silness & Löe 1964), and the PBI (Saxer & Mühlemann 1975) were recorded. Thereafter, each participant received the assigned toothbrush and instructions by a person not involved in the study. The duration of the instructions was approximately 3 min. for each product. For the electric toothbrushes, these instructions followed the manufacturer's recommendations. For the manual toothbrush, the Bass 1954 technique was demonstrated. The brushing time was set for 2 min., and the brushing frequency was two times/day. To control the brushing time, each subject was provided with a digital stop watch. Four weeks and 8 weeks after baseline, the indices were recorded again. During the study period, the use of mouthrinses, gels and interdental cleaning aids was prohibited. The intentional use of a toothpick to remove impacted food was allowed. All participants used the same toothpaste (Elmex).

All examinations were treatment-blind and performed by one examiner (J.S.). The intra-examiner reliability was tested with repeated measurements resulting in reliability-coefficients of 0.87 (API), 0.86 (QHI), and 0.69 (PBI) (Cohen's κ-test, $p < 0.001$). The statistical analysis was performed with the SPSS 11.0 program using the Mann–Whitney *U*-test for nonparametric unrelated samples. For each analysis, the statistical unit was the individual.

Fig. 1. The three tested toothbrushes (from left to right): Elmex Super 29, Braun Oral B 3D Excel, Cybersonic.

Table 1. Medians (5th, 95th percentile) of API, PBI, and QHI at baseline and after 4 and 8 weeks, respectively

	Elmex	Braun	Cybersonic
API			
Baseline	2.16 (1.78/2.50)	2.30 (1.84/2.60)	2.23 (1.76/2.67)
4 weeks	2.09 (1.76/2.48) a*	2.02 (1.56/2.31)	2.00 (1.38/2.36) a*
8 weeks	2.13 (1.78/2.48) a‡, b‡	1.84 (1.44/2.26) a‡	1.99 (1.37/2.25) b‡
PBI			
Baseline	1.17 (0.64/1.96) a†	1.37 (0.75/2.18)	1.39 (0.81/2.36) a†
4 weeks	1.17 (0.63/1.90) a†	0.89 (0.38/1.62) a†, b†	1.15 (0.52/2.07) b†
8 weeks	1.21 (0.68/1.80) a‡	0.71 (0.27/1.51) a‡, b‡	1.01 (0.38/1.76) b‡
QHI			
Baseline	2.23 (1.85/2.66)	2.29 (2.08/2.62)	2.32 (2.07/3.00)
4 weeks	2.15 (1.80/2.57)	2.04 (1.78/2.52)	2.11 (1.52/2.45)
8 weeks	2.16 (1.82/2.52) a‡,b†	1.92 (1.36/2.35) a‡	1.99 (1.42/2.31) b†

Groups with same letters are significantly different, by respective index.
*$p < 0.05$.
†$p < 0.01$.
‡$p < 0.001$.
API, approximal plaque index; PBI, papillary bleeding index; QHI, Quigley–Hein plaque index.

The study was approved by the ethics committee of the Charité Berlin, Germany.

Results

All subjects could be included in the final analysis. The average age was 34.1 (12.3) years (mean, SD). No statistically significant differences were found between groups (ANOVA, Bonferroni posthoc test). Sexes were equally distributed to the groups. Clinical results are presented in Table 1 and Figs 2–4. Since API, PBI, and QHI showed small, but in case of PBI statistically significant differences between groups at baseline (Table 1), improvements of the indices after 4 and 8 weeks were calculated for comparison between groups. After 4 and 8 weeks, with respect to all indices, the use of the power toothbrushes resulted in improvements which were statistically significant superior to what was found for the manual brush ($p < 0.001$) (Figs 2–4). The D 17 was superior to the Cybersonic with respect to API after eight weeks ($p < 0.05$) and PBI after 4 and 8 weeks ($p < 0.01$) (Figs 2 and 4).

Discussion

In the present study, the Cybersonic and the Braun Oral B 3D Excel were more effective in reducing plaque and gingivitis than a manual brush. For data analysis, changes after 4 and 8 weeks were used because small differences were found between baseline values. On the other hand, the analysis of the

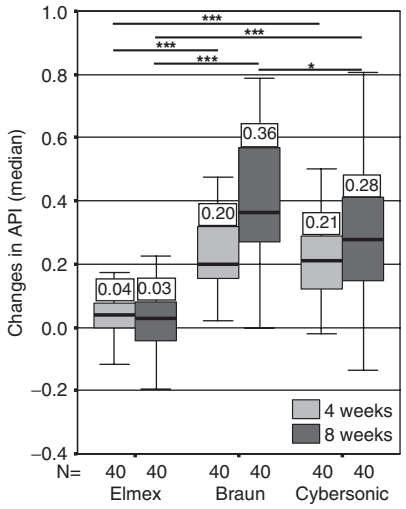

Fig. 2. Changes of approximal plaque index (API) between baseline and 4 weeks as well as between baseline and 8 weeks. The box and whisker-plots demonstrate medians, 25th, 75th percentile, and ranges. Horizontal bars indicate statistically significant differences (***$p < 0.001$, *$p < 0.05$).

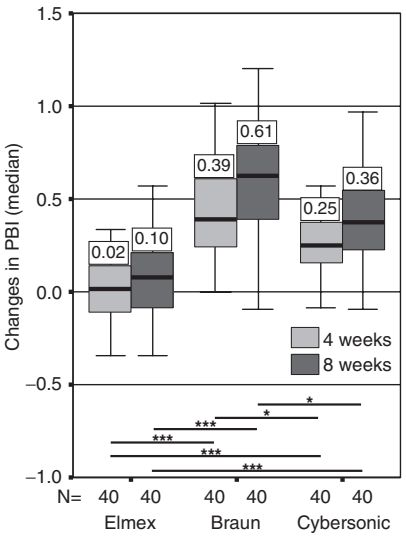

Fig. 3. Changes of papillary bleeding index (PBI) between baseline and 4 weeks as well as between baseline and 8 weeks. The box and whisker-plots demonstrate medians, 25th, 75th percentile, and ranges. Horizontal bars indicate statistically significant differences (***$p < 0.001$, *$p < 0.05$).

absolute values in Table 1 shows, that the Braun Oral B 3D Excel was significantly superior to the manual brush after 4 (PBI) and 8 weeks (all indices). With respect to API (4 and 8 weeks) and QHI (8 weeks), this was also true for the Cybersonic. These findings demonstrate, that the superiority of the power toothbrushes as seen in the analysis of the changes of the indices

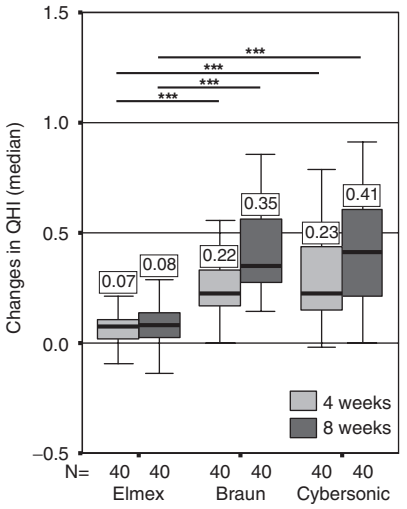

Fig. 4. Changes of the Quigley–Hein plaque index (QHI) between baseline and 4 weeks as well as between baseline and 8 weeks. The box and whisker-plots demonstrate medians, 25th, 75th percentile, and ranges. Horizontal bars indicate statistically significant differences (***$p < 0.001$).

over time (Figs 2–4) cannot be attributed to the fact that the users of the manual brush started with a lower baseline value.

During the study, the use of inter-dental cleaning aids was prohibited except for a toothpick to remove impacted food. At the screening examination, less than five subjects reported former use of inter-dental cleaning aids. This reflects the fact, that only 3% of the German population are using dental floss on a regular basis (Hilfinger 2001). All individuals accepted to refrain from the use of inter-dental cleaning aids during the study period. Therefore it can be assumed that no inter-dental cleaning aids were used during the study period. Considering the fact, that the study population was stratified by oral hygiene status, even the intentional use of interdental cleaning aids should not have influenced the study outcome.

Whereas no published clinical data are available for the Cybersonic, there are two studies comparing the Braun Oral B 3D Excel (D 17) with a manual brush (Warren et al. 2001, Sharma et al. 2002). In their 9 weeks crossover study, Sharma et al. tested the D 17 in combination with a regular toothpaste whereas an anticalculus dentifrice was used with the manual brush. With respect to calculus removal, the D 17 was as effective as the manual brush/anticalculus toothpaste combination. However, with respect to the present study, no conclusions can be drawn from the paper of Sharma et al. since between groups, two parameters had been different (brush and toothpaste). The study of Warren et al.(2001) gives better information about the efficacy of the D 17 in comparison with a manual brush. Plaque and gingivitis indices were recorded. After 3 months, the D 17 was superior to the manual brush with respect to reductions in plaque and gingivitis. This is in accordance with the present 8 weeks-study.

In earlier studies, we found no difference between manual brushes and preceding models of the Braun Oral B 3D Excel (Zimmer et al. 1999a, b). The different present findings may be explained by the fact that the D 17 is combining rotary with high-frequency pulsating (333°Hz) movements.

In a previous study, the sonic toothbrush Ultra sonex was tested using the same design as it was applied in the present trial (Zimmer et al. 2002). After 8 weeks of use, the Ultra sonex showed reductions of 1.41 for the QHI, and 0.36 for the PBI. While the results for the PBI were exactly the same in the present study for the Cybersonic, (Fig. 2), those for the QHI were largely different (1.41 *versus* 0.41). According to the manufacturer, the bristles of both devices are oscillating with a high frequency (Ultra sonex: 250 Hz, Cybersonic: 342 Hz). However, a videographic analysis of the bristle movements of both products showed an amplitude of 2 mm for the Ultra sonex, whereas almost no amplitude was seen at the Cybersonic. In this product, no homogenous bristle movement could be seen and a few tufts only where slightly vibrating. As already mentioned in the introduction, the effective plaque removal of sonic toothbrushes could be caused by a microstreaming in the saliva–toothpaste–slurry which was shown for the Sonicare (Hope et al. 2003, Hope & Wilson 2003). The frequency of the Sonicare is 250 Hz and its amplitude is about 3–4 mm. It can be speculated that the amplitude of the Ultra sonex is still large enough to produce microstreaming whereas the slight vibration of the Cybersonic bristles is not.

In our earlier study, evident improvements were found with respect to the PBI, indicating a gingivitis reduction in the approximal area (Zimmer et al. 2002). However, the API was not reduced. It was speculated, that the

original API, which is based on a yes/no-decision, may be not sensitive enough to indicate plaque reductions in the approximal area. Therefore, a modification of the API (Lange et al. 1977) with a scoring system from 0 to 3 (Silness & Löe 1964) was used in the present study. The results of this modified API (Fig. 2) showed good accordance with the PBI (Fig. 3) which seems logical since both indices are evaluating the same area and a strong association between plaque and gingivitis has been demonstrated (Löe et al. 1965).

It can be concluded from the present study, that the Braun Oral B 3D Excel and the Cybersonic may be more efficacious than manual toothbrushes in removing plaque and preventing gingivitis in patients without severe periodontal disease.

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